

Claims Listing:

What is claimed is:

Claim 1 (currently amended): ~~Design methods and apparatuses of~~ A method of producing photodiodes with adaptive structures to ~~that~~ achieves smooth and wavelength-selective photo-responses ~~comprises~~ comprising the following steps:

- (1) utilizing ~~the way of~~ signal summation to yield ~~the a~~ uniform distribution of the photo-response ~~to be beneficial to the simplification on the design of the back-end compensation circuits, whereby said utilization simplifies back-end compensation circuit design;~~
- (2) determining ~~the adequate values of the~~ semiconductor process parameters values of the ~~semiconductors~~ to achieve ~~the a~~ maximum photo-response as well as to acquire ~~the a~~ photo-response with ~~the a~~ peak value at a specific wavelength, and
- (3) ~~designing the photodiode with multiple PN junctions to provide multiple photo-responses without using color filters in cooperation with the adequate layout design of this photodiode~~ providing multiple photo-responses by utilizing a multiple PN junctioned photodiode without a color filter.

Claim 2 (currently amended): ~~The design methods and apparatuses of photodiodes with adaptive structures to achieve smooth and wavelength-selective photo-responses as mentioned in claim 1, where the method (1) utilizes the way of signal summation to generate the uniform distribution of the photo-response of the photodiode to be beneficial to the simplification of design on the back-end color compensation circuits and this method (1) is described as follows~~ The method of producing photodiodes with adaptive structures of Claim 1 where said back-end color compensation circuit is formed using the following method:

(a) ~~it is designed directly from the photo-sensing area of the photodiode and by performing the layout design to construct photo-sensing areas, utilizing said photo-sensing area where~~ the area size is ~~in~~ reversely proportional to the photo-response of the photodiode and utilizing adequate photo-sensing areas of multiple photodiodes to obtain multiple photo-responses, ~~these photo-responses are summed together~~ summing together said photo-responses to yield the smooth distribution of the total photo-response in all sensed wavelengths;

(b) ~~it is explored by using the~~ connecting each photodiode separately to a back-end amplifiers to equalize said photo-sensing areas ~~where in order to make the photo-sensing areas of photodiodes be the same size each photodiode is~~

~~connected to an amplifier, such design conforms the specification requirements that~~
~~each whereby a gain of these each~~ amplifiers is ~~in~~ reversely proportional to the
photo-response ~~and~~ where multiple photodiodes produce the photo-response
signals, ~~after being enlarged through the amplifiers, and after amplification that are~~
~~added~~ said photo-response signals are added together to generate the smooth
distribution of the total photo-response;

(c) ~~by means of the schemes of utilizing~~ (a) and (b), ~~the size of the photo-sensing~~
area and the ~~gain of the back-end amplifier~~ gain are to be calculated and
determined such that the gain ratios of said multiple photodiodes are the reciprocal
of the corresponding size ratios to obtain the smooth distribution of the total photo-
response.

Claim 3 (cancelled):

Claim 4 (currently amended): The design methods ~~and apparatuses are as~~
mentioned in claim 1, where ~~the method (3) of designing the color photodiodes~~
without color filters is ~~proposed~~ established by using the following method: ~~the~~
~~photodiode with multiple PN junctions and multiple switches to generate multiple~~

~~photo-responses for sensing multiple colors where first the photodiode is developed with multiple PN-junctions to provide enough sets of photo-responses as well as to make more variations for the photo-responses and since the overall photo-responses for a photodiode is the summation of the photo-responses from all PN-junctions, the proposed method is to separate and take out one from multiple sets of photo-responses by shorting the undesired PN junctions where the electron-hole pairs in the shorted junctions are to be generated and recombined again and again where the photo-currents contributed by such shorted junctions would be erased and where the other PN junctions without shorting can accumulate their photo-responses to generate the total photo-responses as demand and regarding to switches for the shorting operations, the layout of connecting each PN junction with a switch is designed and when the P and N layers are connected by using a conducting material, this PN junction becomes the shorting status and thus does not generate the photo-current and at such condition, the switch for this can be viewed as the "close" status where on the other hand, when the P and N layers are not connected by using a conducting material, this PN junction is the opening status and thereby yields the photo-current and the switch for this PN junction at such condition can be treated as the "open" state and by using the switches to~~

~~determine which ones of multiple PN junctions are used, the unshorted PN junctions can generate the required total photo responses to interpret a specific color and the photodiode with multiple PN junctions and multiple switches can sense multiple colors at different switching conditions~~

directly changing a chip layout without using extra color filters to achieve photo responses of color photo pixels;

_____ establishing a multi layered PN junction fabrication process to provide a lowest concentration in the scope of said fabrication process of various photo responses;

_____ separately picking out a photo response of an individual frequency band;

_____ short circuiting unnecessary PN junctions to recombine the electrons and holes produced restlessly on the PN junctions thereby diminishing the photo currents contributed by these PN junctions;

_____ summing said photo responses;

_____ creating a switching function for said PN junctions by modifying chip layout design; where said switch has an off-switch created by connecting said P and N photodiode terminals thereby short circuiting said PN junction of said photodiode and where said switch has an on-switch created by disconnecting thereof to

produce photo current therethrough, thus creating an on-switch;

_____ using said specified photo signal selectional method so that a desired

photo response can be effectively achieved.